### Video-clip transfer of radiological images using a mobile telephone in emergency neurosurgical consultations (3G Multi-Media Messaging Service)

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Video-clip transfer of radiological images using a mobile telephone in emergency neurosurgical consultations (3G Multi-Media Messaging Service)

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Abstract

Background

The purpose of this study was to validate and assess the accuracy and usefulness of sending short video clips in 3gp file format of an entire scan series of patients using mobile telephones running on 3G-MMS technology, to enable consultation between junior doctors in a neurosurgical unit and the consultants on call after office hours.

Method

A total of 56 consecutive patients with acute neurosurgical problems requiring urgent after-hours consultation during a 6 month period prospectively had their images recorded and transmitted using the above method.

The response to the diagnosis and the management plan by two neurosurgeons (who were not on site) based on the images viewed on a mobile telephone were review by an independent observer and scored. In addition to this a radiologist reviewed the original images directly on the hospital’s Patients Archiving and Communication System (PACS) and this was compared with the neurosurgeons response.

Results

Both neurosurgeons involved in this study were in complete agreement with their diagnosis. The radiologist disagreed with the diagnosis in only one patient, giving a kappa coefficient of 0.88 indicating an almost perfect agreement.

Conclusion

The use of mobile phones to transmit MPEG video-clips of radiological images is very advantageous for carrying out emergency consultations in neurosurgery. The images accurately reflect the pathology in question which in turn reduces the incidence of medical errors from incorrect diagnosis which otherwise may have just depended on verbal description.

Keywords: Mobile phone; teleconference, neurosurgical emergency; consultation; teleconference;
Video-clip transfer of radiological images using a mobile telephone in emergency neurosurgical consultations (3G Multi-Media Messaging Service)

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Introduction

The use of mobile telephones in transmitting critical medical data especially in emergencies is on the rise. The term M-Health was defined in a paper by Istepanian as emerging mobile communications and network technologies for healthcare. It represents the evolution of traditional e-health systems from desktop platforms and wired connections to the use of more compact devices and wireless connections (1).

In the field of emergency neurosurgical consultations several authors including ourselves have proposed the use of mobile telephones (2, 3). This method is useful when consulting on problems such as head-injuries and intra-cranial haemorrhages and it involves transmitting single CT images using a JPEG format using Multimedia messaging services (MMS) over standard mobile telephone line. However problems using this technique result from the fact that discussions are carried out over a single image that has been selected to best represent the area of interest. If further images are required to make the necessary decisions these new images have to be sent individually which takes time.

The purpose of this study was to validate and assess the accuracy and usefulness of sending short video clips in 3gp file format of an entire scan series of patients using mobile telephones running on
3G-MMS technology. This was to enable consultation between junior doctors in a neurosurgical unit and the consultants on call after office hours.

**Methods and Material**

All video-images were obtained using a variety of mobile telephones with MMS and video recording capabilities. The inbuilt cameras in the mobile telephones used in this study had resolutions ranging from 3 to 5 megapixels. The images were recorded directly from the screen of the CT scan console by scrolling down the images. Video setting on the mobile phones were adjusted to ‘sharing mode’ and this generally allowed a 20 second clip with a maximum of 300kbs of data per clip in 3gp file format. This is a stripped down format of MPEG files that allows transmission over the mobile network using MMS configuration. Most mobile phones also allow text messages to be included in the MMS. This option has the advantage of allowing the sender to include important clinical information such as age, Glasgow Coma Scale (GCS), mode of injury and other co-morbid problems. The 3gp clip was then transmitted as an MMS message over a variety of 3G networks run by various local mobile telephone service providers.

A total of 56 consecutive patients with acute neurosurgical problems requiring urgent after-hours consultation admitted to a university hospital during a 6 month period had their images recorded and transmitted using the above method. This was followed by a telephone discussion of the scan and the patients’ clinical condition between the admitting doctor and the neurosurgeon on-call who was not on site.

All images were reviewed on a Nokia N95 Communicator™ by the senior author. The images were stored and reviewed on a later date by a second neurosurgeon on the same hand-set. The response to the diagnosis and the management plan by the two neurosurgeons were then review by an independent observer and scored. In addition to this a radiologist reviewed the original images.
directly on the hospital’s Archiving and Communication System (PACS) console and his diagnosis was compared with that of the first neurosurgeon and scored by the independent observer once again. All data was collected in a prospective manner.

Results

A total of 56 consecutive consultations that were carried out in a one year period and involved a variety of problems that ranged from head trauma, spontaneous haemorrhages and post operative complications. (Table 1)

Both neurosurgeons involved in this study were in complete agreement with the diagnosis in all 56 patients whose images were transmitted for consultations.

When a comparison of images transmitted over the mobile networks were compared with the original images on a standard radiological PAC viewer, the senior author and the radiologist were in agreement over the primary diagnosis in 55 of the 56 patients (98%), giving a kappa coefficient of 0.88 indicating an almost perfect agreement.

The radiologist however did have the advantage of being able vary the contrast and magnification on the PACs viewer that allowed him to observe smaller changes. In the single consultation where there was a difference where the radiologist noted a sliver of an extradural haematoma that was only visible on a single slice of the CT scan. The diagnosis was only possible by varying the window settings on the console. However these changes would not have affected our management plan for the patient concerned.

When the management decisions made by the neurosurgeons based on their diagnosis were carried out there was a difference in management in 6 of the patients (11%). This gave a kappa coefficient of 0.77 suggesting a significant correlation between the two observers in their management plan based on the images transmitted. In all 6 patients the diagnosis made was similar between both
observers, we therefore concluded that this difference was essentially due to professional
differences in opinion on the management.

Discussion

The ideal neurosurgical consultation between doctors usually requires the visualization of images in
addition to clinical information such as history and physical findings. Many hospitals do not have a
resident neurosurgeon 24 hours a day and initial management is initiated by residents or
non-neurosurgeons especially on weekends and after office hours. Moreover, it is also a problem if
long distance consultations are required and conventional image transfer technology is unavailable.
In most instances the scan images are described in words and its interpretation is left to the
imagination of the doctor being consulted leaving room for errors to occur.

This matter has been overcome with the use of the internet to transmit images of the cases being
discussed. The use of internet or telemedicine however has its limitation as both parties must have
access to a computer and the necessary soft-ware that allow image transfer. This is also an
expensive option as this method often involves licences that have to be bought and renewed yearly
and place limits on the user numbers. Portability is an issue as any telemedicine network structure
requires a dedicated console with a specific IP address to ensure secured connection and
communication.

Some authors have proposed the use of JPEG images sent on mobile phones suing MMS technology
as a possible alternative for emergency consultations (4). This method is especially useful if only
single images are required such as in orthopaedic surgery (5, 6). However when CT or MRI images
need to be sent the presence of multiple images requires the physician to choose a single image that
is most representative of the pathology. If more information is required further images have to be
sent. This adds time and is often inconvenient to the physician initiating the consultation that has to
chose and send further images and to the surgeon being consulted who has to wait for these images for the consultation to progress (2).

Transmitting medical data over mobile devices for consultation have been carried out in the transmission of ECG traces either between patients and their physicians (7, 8) or between emergency services from an ambulance to the base hospital (9, 10). Plastic surgeons have also used a similar technique to carry out video conferencing regarding soft tissue injuries and burns assessments (11, 12, and 13).

This study demonstrates that this method of transmits images of sufficient quality to base emergency decisions for patients with neurosurgical problems. Most images transmitted during an emergency are usually cases of haemorrhage or hydrocephalus which are pathologies that are easily identified as they contrast quite significantly from the brain parenchyma.

The use of MPEG clips allows all images to be seen in one transmission. This is especially useful when additional information such as mass effect and cisternal effacement can be obtained. Additionally the images can also be paused and magnified (within limits) to obtain a more accurate diagnosis.

Using this method of consultation it is our opinion that the emergency neurosurgical service has improved significantly as all images are now being review by a consultant neurosurgeon irrespective of the location of the neurosurgeon or the time of day. The availability of visual images in our opinion improves the quality of our emergency communication compared to just a verbal account of images available.

In our experience if CT images needing to be sent involve both non-contrasted and contrasted images, it is best to send them as two separated messages.

This method however does have its drawbacks as one is unable to adjust the contrast of the images on the mobile telephone which means that the sender has to ensure that the best settings for the images are selected before recording and transmitting the images.
Images also take time to transmit and this may range from 1 minute to about 15 minutes. We have found that during peak times of the MMS services such as public holidays and when seasonal greetings are being sent over the system, this method of consultation may be delayed indefinitely, in which case consultations will have to fall back onto conventional methods.

The use of mobile telephone to transmit MPEG-CT scans images of patients with acute intra-cranial pathologies for after hour’s consultations between junior doctors and senior consultants has changed our work process when after hours consultations are required.

While this is a study focused on patients with acute neurosurgical emergencies, we are of the opinion that it is a useful tool when carrying out consultations requiring the review of medical images that involve multiple slices of sectional anatomy.

**Conclusion**

The use of mobile phones to transmit MPEG video-clips of radiological images is very advantageous for carrying out emergency consultations in neurosurgery as the images transmitted accurately reflect the pathology in question.

**Acknowledgment**

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**Conflict of interest statement**

None of the authors involved in this study have associations that may give rise to issues of conflicts of interest in the preparation on this study.

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This study was approved by the Ethics Committee of the University of Malaya Medical Centre.
References


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Table 1 Variety of cases consulted on